TUNOM UAV Team

ODLC (Object Detection, Localization, and Classification) Pipeline:

- **Main Camera Selection:**

  The criteria the team put to select their camera were high resolution, stabilization, software compatibility, lightweight design and electromagnetic inference immunity.

Camera Selection

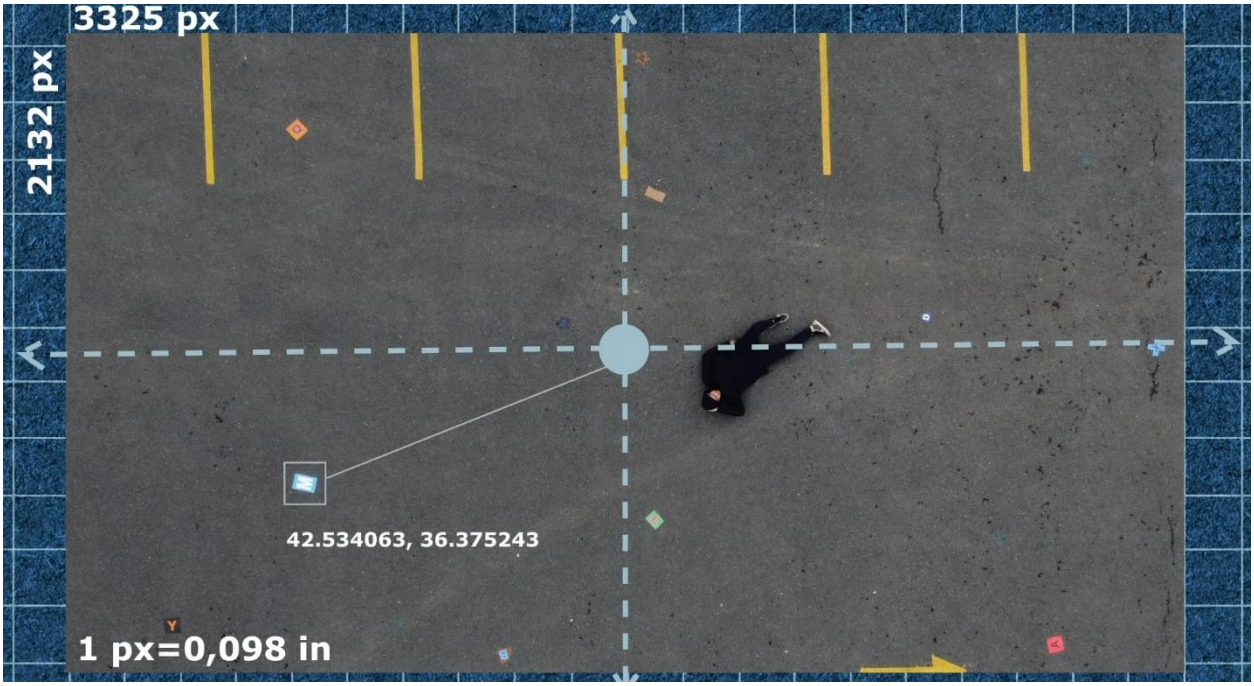
	Raspberry Pi HQ	Arducam Mini Module	Sony Alpha a7 III
Resolution	12.3 MP	5 MP	24.2 MP
Stabilization System	Yes	None	Yes
Software Support	Extensive	Limited	Limited
Weight	Light	Light	Heavy
EMI Durability	Moderate	Low	Moderate
Lens Compatibility	Wide Range	Limited	Wide Range

  They Chose the Raspberry Pi HQ camera with a 42 mm variable focal seamount length.

- **Model For Object Detection:**

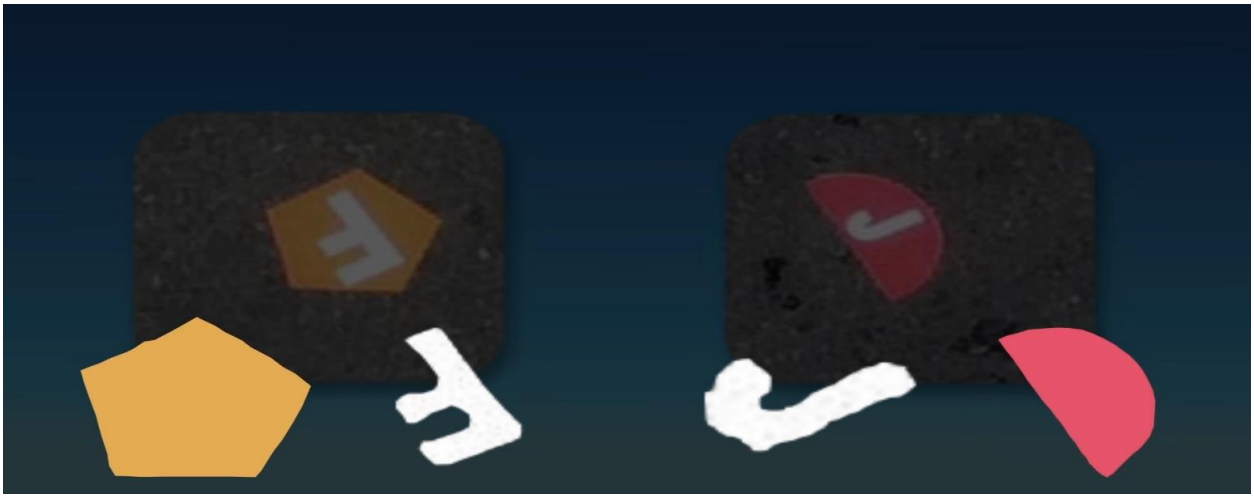
  They developed a YOLO v8 AI model for ground object detection that is trained on diverse image sets for robust real-world applications.

- **Localization:**

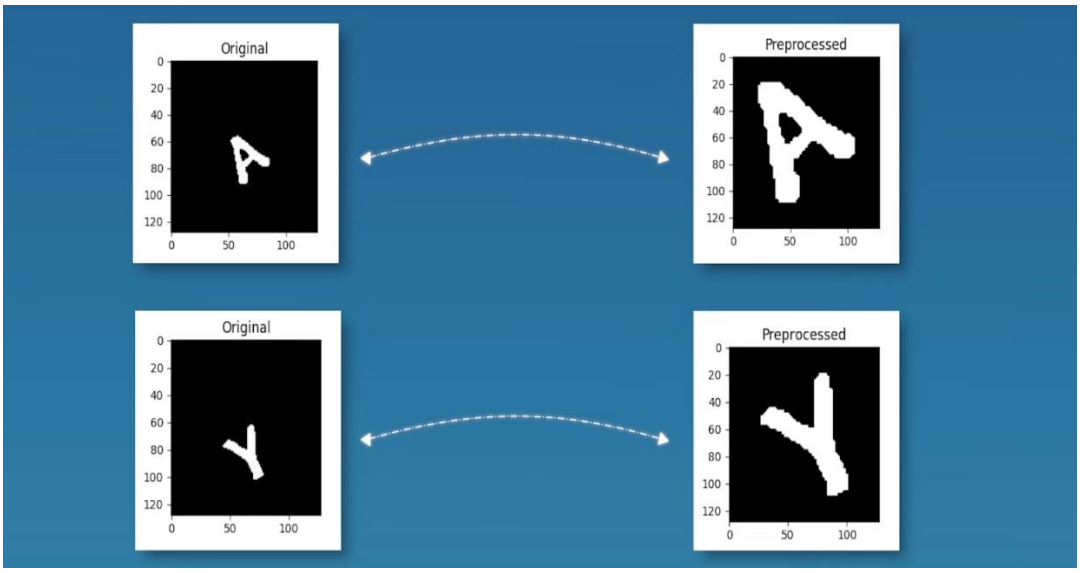


They manually calculated the coordinates of the object with high accuracy using the field of view, focal length, image size and altitude parameters.

- **Data and Image Processing**

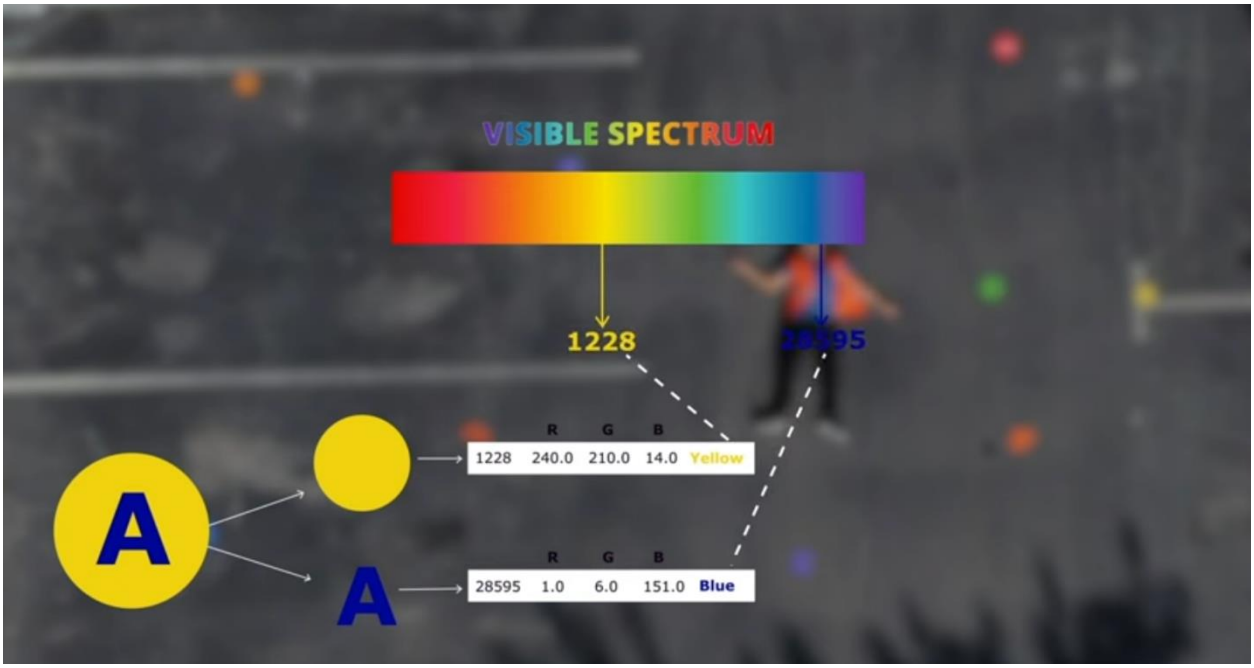


They trained an original AI model to separate the leathers and the shapes of the object in the photograph from each other.



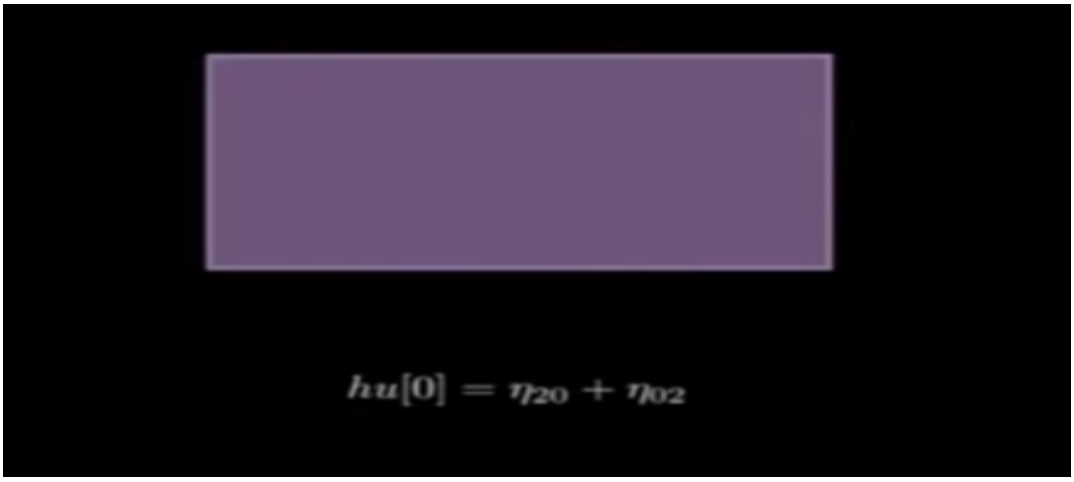
They have used image preprocessing to center and enlarge leathers in photos enhancing model clarity and accuracy for more precise leather recognition.

- **Color Recognition**:



Their color recognition system features highly accurate neural network that is capable of identifying colors and image with a 99% accuracy.

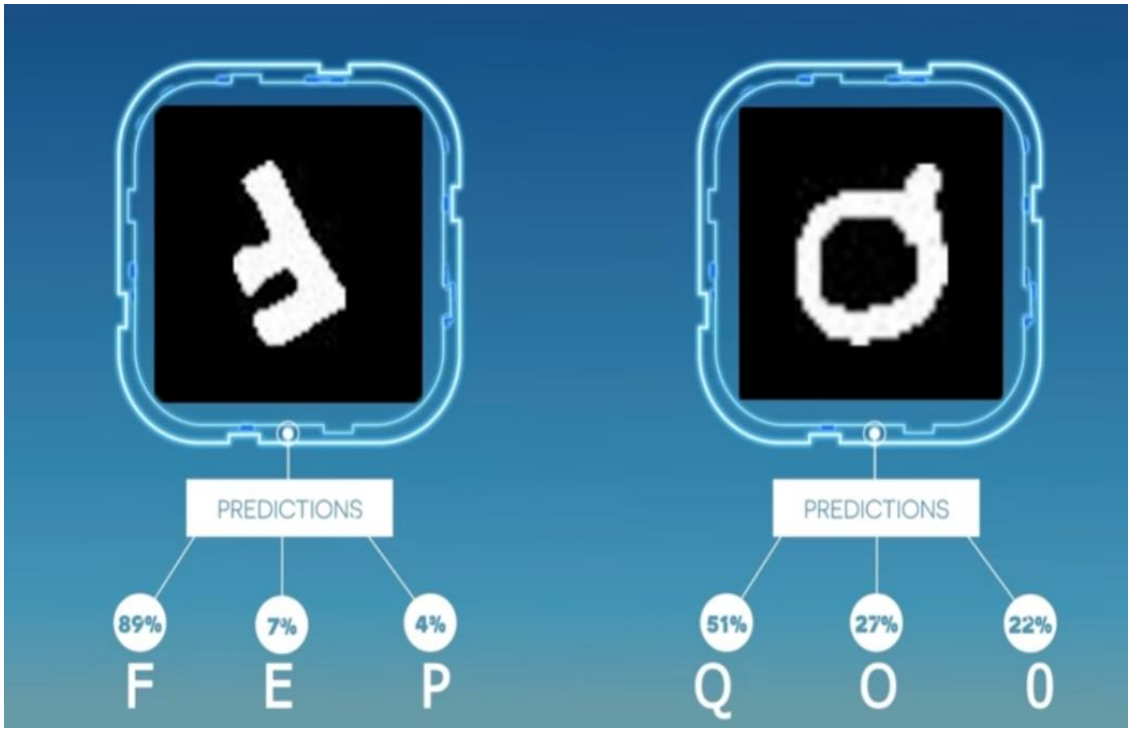
- **Shape Recognition**:



They identify the shapes in the photograph using the hu moments values.

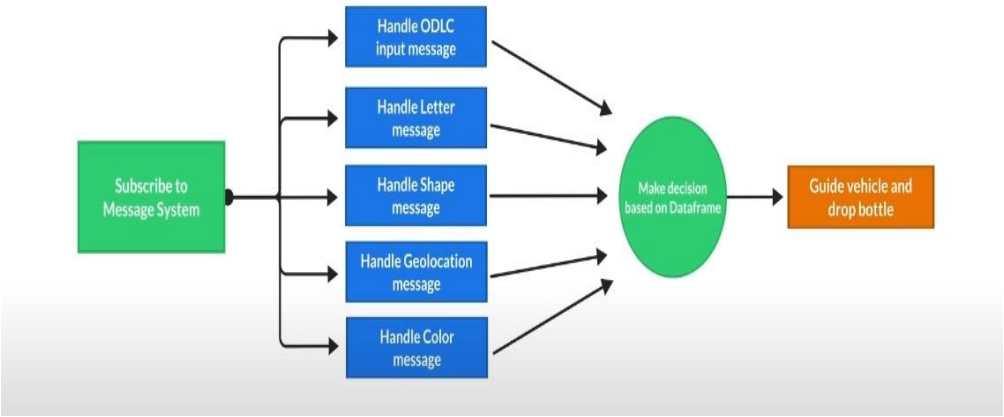
This method relies on quantitatively evaluating various features in the image.

- **Character Recognition**:



They trained an AI model, and they enhanced its accuracy by training it with various leather examples extracted from photographs that they captured.

- **Data Processing and Evaluation System:**

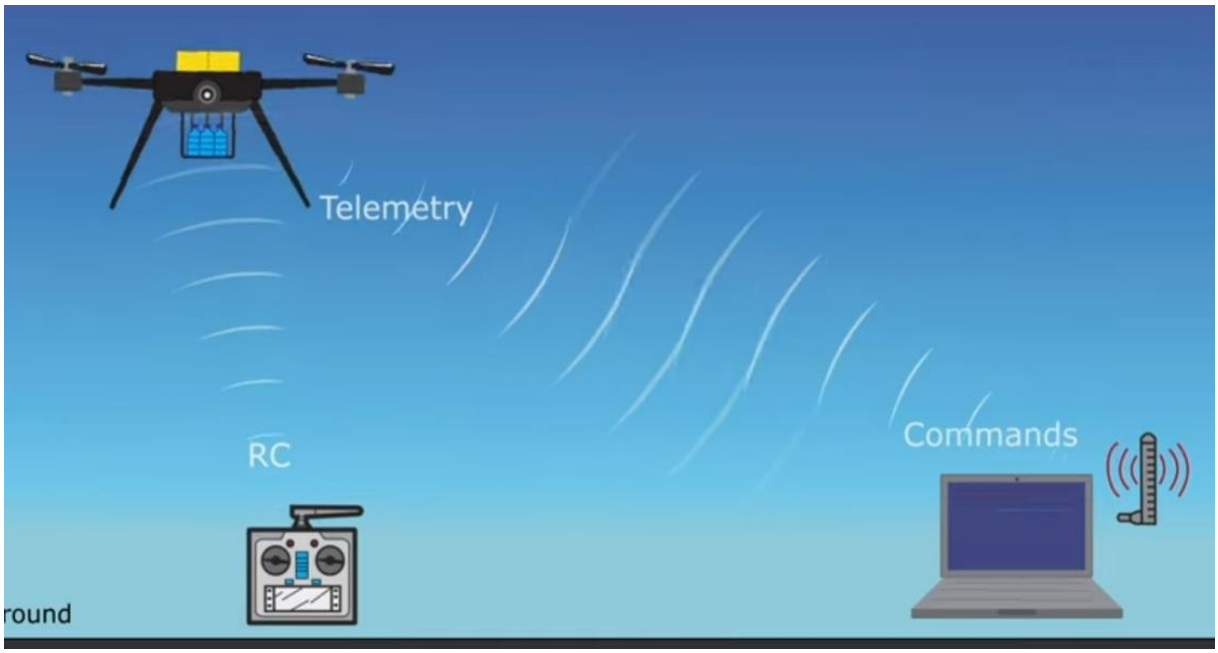


They developed their system to process simultaneously to avoid loss of time.

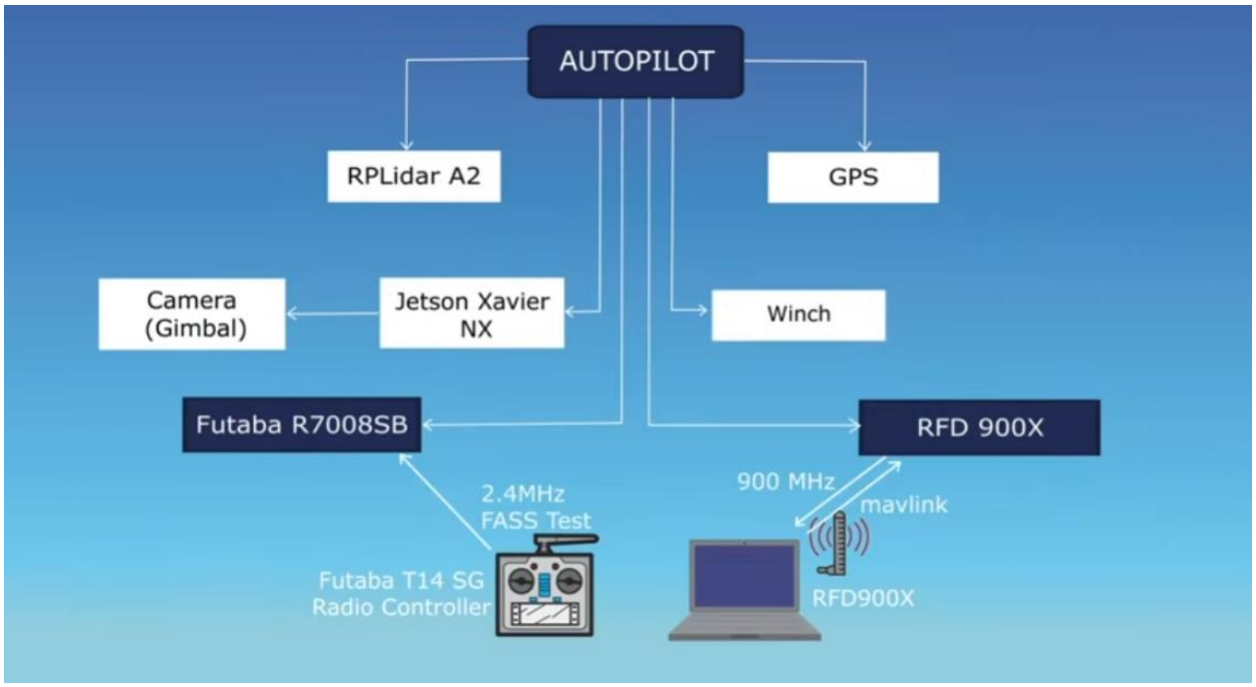
The ROIS detected in this communication system are first separated from each other by shapes, letters and their colors and they are processed in different systems at the same time.

Afterwards the data are collected in the same data frame without mixing, the decision mechanism works with the data in the data frame and detect the correct shape.

Communication systems:

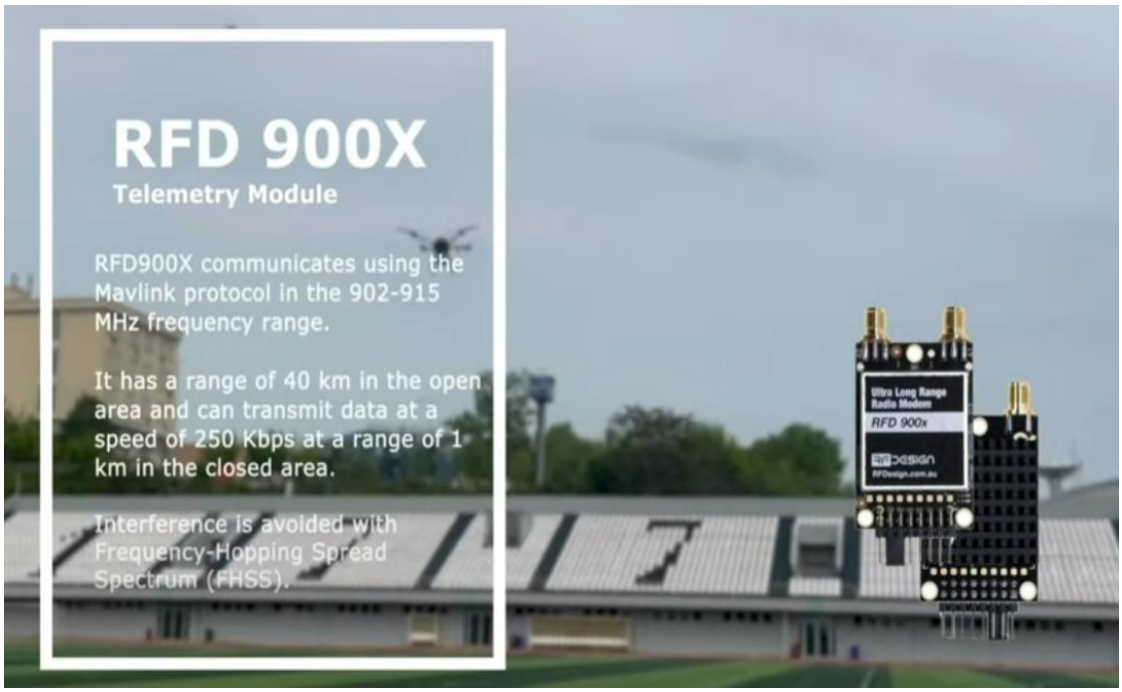


Their communication system consists of the telemetry modem and RC receiver to carry out the mission.



This is their communication diagram that shows how all the components relate to each other. From the diagram we can see that they use Jetson Xavier NX as their onboard computer, however they did not clearly show it is connected to the ground station.

- **Telemetry link:**

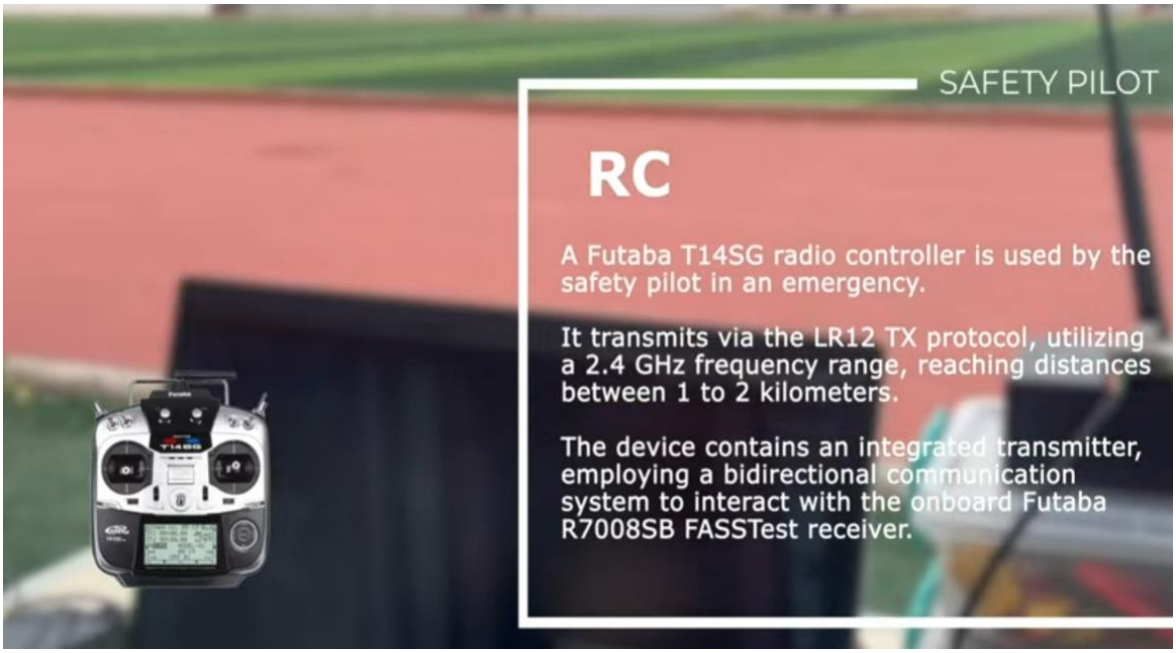


The RFD 900x is used as a radio modem to transmit telemetry data in both the ground station and the aircraft in 900 MHz frequency band with a range of 40KM and it uses the Mav link protocol for communication.

It has frequency hopping separate spectrum which prevents frequency interference with other radio modems that can use 900 MHz frequency band.

It can transmit telemetry data and command and control that can be used for arming the vehicle and starting the autonomous mission.

- **RC Link:**



The safety pilot uses a Futaba T14SG radio controller, which can broadcast at 2.4GHz bandwidth with a range of 2KM to communicate with the UAV through the onboard receiver.

- **Communication Summary:**

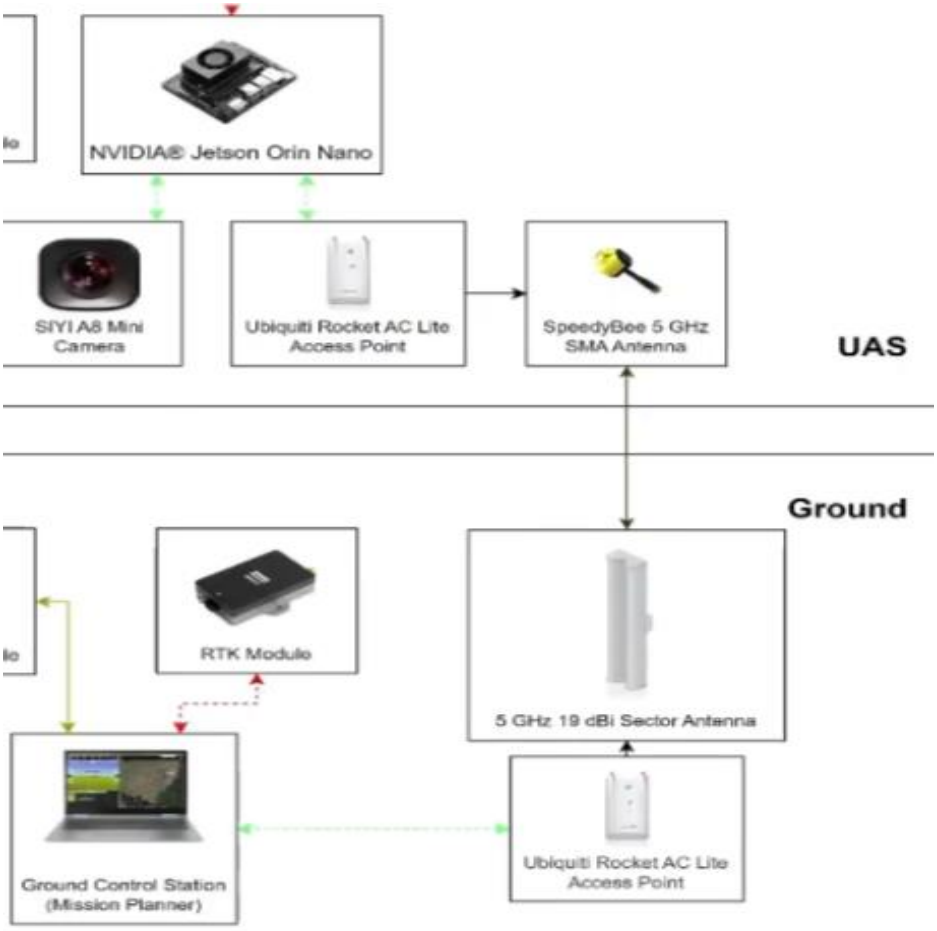
The test they conducted on RFD 900X showed that the received signal indication value averaged 229.182 at 1000 feat. Also, according to the test with a packet loss rate of 2%, the efficiency was observed to be above 98%, the signal strength

of the data received from the remote control at the same distance was seen to be 95%.

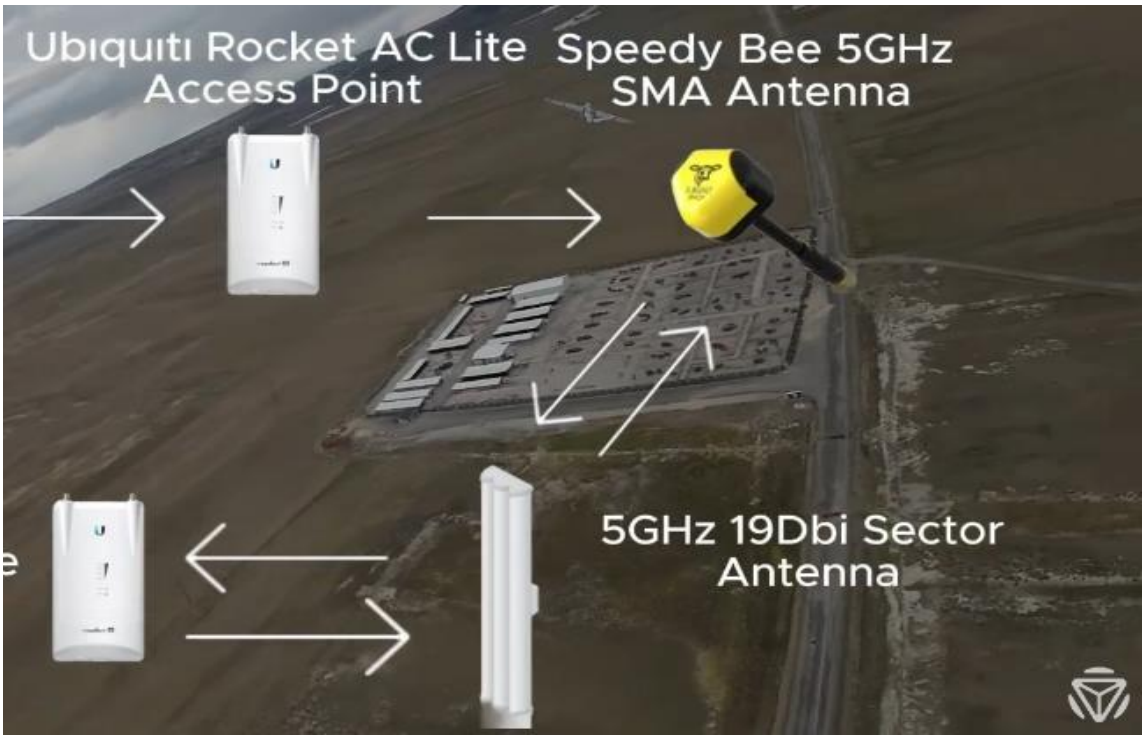
Additional Insights:

As the TUNOM team has not provide a clear demonstration of either they use a WIFI link or not in this section we will discuss the WIFI link of another team.

- WIFI Link (**EFLATUN UAV Team)**



To achieve a WIFI connection from the ground station to the UAV the use the Ubiquiti WIFI module that helps them to transmit video feed and mission data.



The system is consisting of four electronic components. The access point they are using has 5GHZ band, that helps to achieve reliable and stable connection.

Their WIFI module is essential for seamless real time communication between the ground control station and the UAS, it enables highspeed data transmission for video streaming functioning reliably over short to medium ranges.

The WIFI modules are enhanced with sector antennas to establish a strong link between the ground station and the UAV.